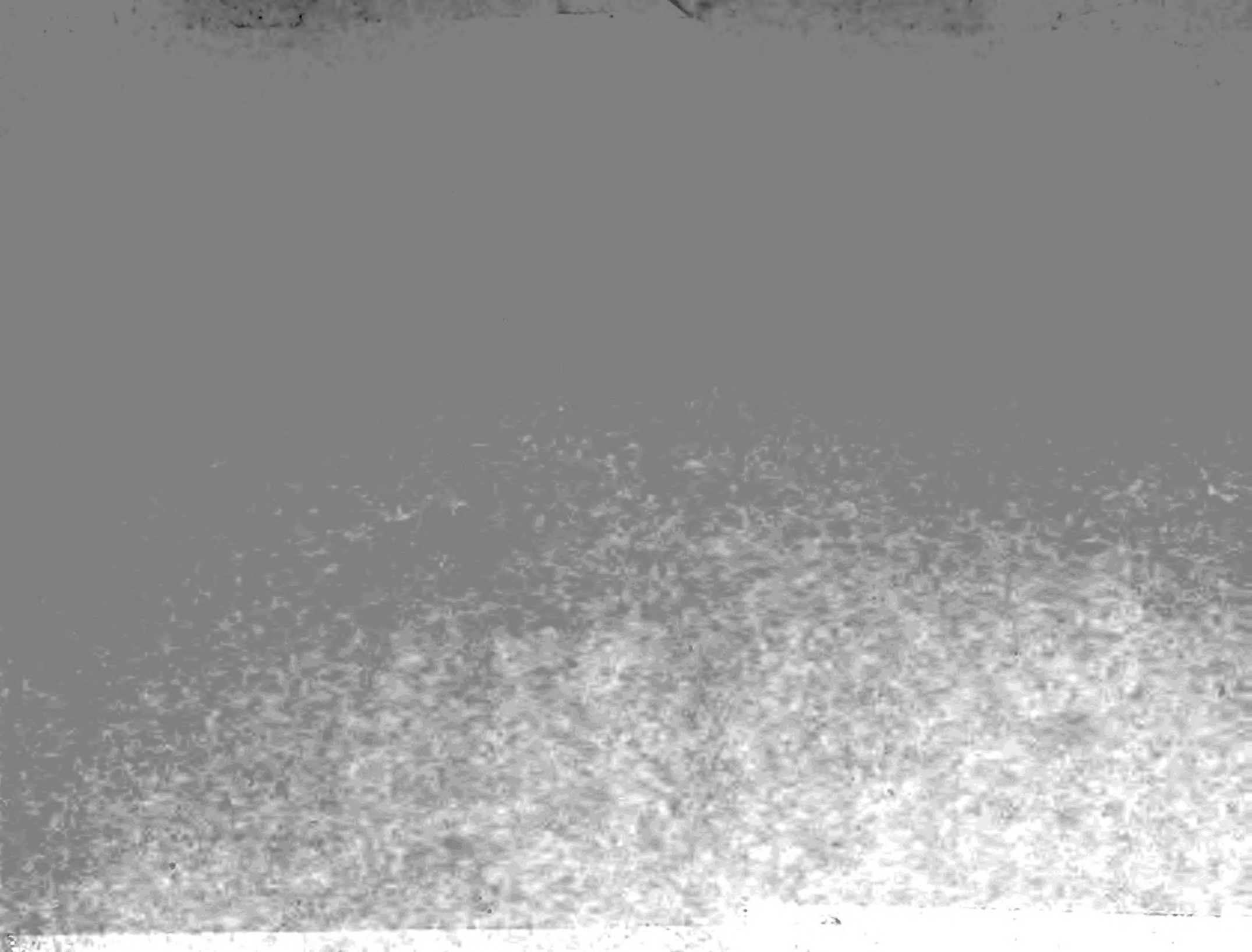

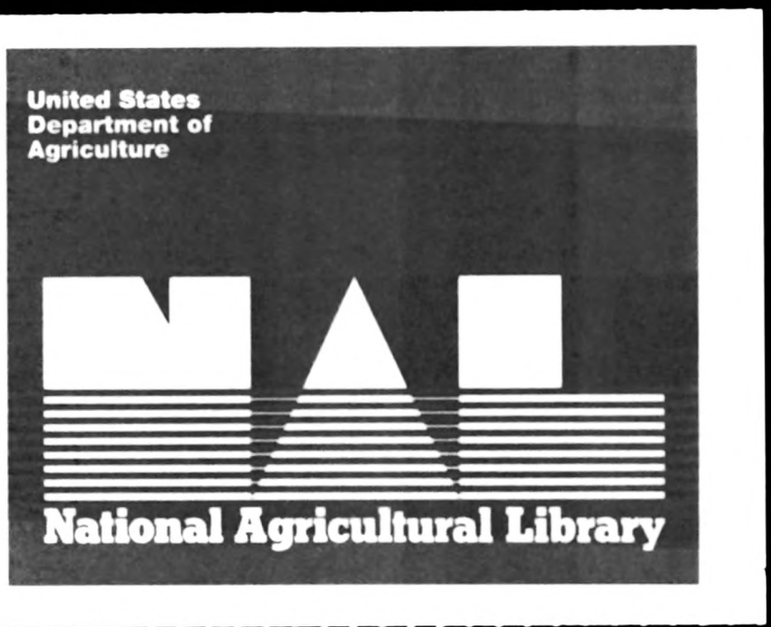
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Final Technical Report, SCA 58-1935-3-013
Title: Effects of agricultural practices upon mycorrhizal fungi.
Principal Investigator: Dr. L.E. Drinkwater
ADODR: David D. Douds

Arbuscular mycorrhizal [AM] fungi are soil fungi which form a symbiosis with the roots of the majority of crop plants. Benefits which the symbiosis imparts to the host plant include increased nutrient uptake, enhanced water relations, and increased pest resistance. The extra-radical phase of the mycorrhiza functions, in effect, as an extension of the root system to more efficiently explore the soil. Given the benefits of this symbiosis, it follows that its utilization should be important in low-input, sustainable agricultural systems shunning chemical fertilizers and pest control. Large scale inoculation of agronomic fields with AM fungi is presently impossible, so it is important to effectively manage indigenous populations.

A series of experiments were conducted at the Rodale Institute Experimental Farm, Kutztown, PA to study the effects of agricultural practices upon indigenous populations of AM fungi. Sampling for AM fungi was conducted in large scale field experiments studying conventional vs low input rotations, conventional vs conservation tillage, and agricultural use of composts.

In the first experiment, spore populations of AM fungi and formation of mycorrhizae in corn and soybean were studied in three farming systems: a conventional corn-soybean rotation and two low-input systems. Low-input plots had higher populations of spores of AM fungi than the conventionally farmed plots. One species, Gigaspora gigantea, was much more numerous in low-input (up to 30 spores 50 cm^{-3} soil) than conventional plots (0 to 0.3 spores 50 cm^{-3} soil. Greenhouse bioassays showed 2.5 to 10 fold greater colonization of plants growing in soil from low-input than conventional systems.

A second experiment was conducted to determine the effect of an overwintering cover crop upon levels of inoculum of AM fungi. Sub-plots with and without the cover crop hairy vetch (*Vicia villosa* L.) were established in the autumn in plots with moldboard plow (MP), chisel-disk (CD), and no-till (NT) treatments in low-input and MP in conventional management. Hairy vetch roots were colonized by indigenous AM fungi by 65 days after planting,

with plants from NT being more colonized than plants from MP or CD plots. The beneficial effect of the cover crop on AM populations in soil was manifested in the spring, with greater spore numbers of the *Glomus* type group in plots with than without cover. A greenhouse bioassay showed that colonization potential of soil collected the following spring was higher in plots with cover than without cover for both farming systems.

In the third experiment, conventional and low-input rotations with tillage treatments ranging from NT to MP were sampled for AM fungi. Soil cores were removed to a depth of 27 cm and divided into 9 cm sections. Spores were isolated from this soil, characterized, and quantified. The effects of tillage upon the fungi varied for different species groups. Some species were more numerous under NT, while others were more numerous in soils under cultivation. In addition, one group was more numerous in the deepest soil section, whereas other groups were more numerous in the top and middle sections.

In the fourth and final experiment, populations AM fungi and mycorrhiza formation were examined in an experiment studying the agricultural application of composted animal manures. Chicken litter/leaf compost and dairy cow manure/leaf compost enhanced spore populations of two AM fungus species type groups relative to those found in plots treated with raw dairy cow manure and conventional fertilizer. Populations of other groups were not affected by amendment, likely due to the large amount of P added in composts and manure relative to the conventional fertilizer applied. Future agricultural applications of compost and manure to provide N for crops need to consider the effects upon VAM fungi of other nutrients in these amendments.

Patent Report: no patents resulted from research conducted under this SCA.

Laurie E. Drinkwater

L. E. Drinkwater

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L. E. Drinkwater